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THIS REPORT CONCERNS THE NATIONAL CENTER FOR SCHOOL AND COLLEGE TELEVISION'S CONFERENCE ON TELEVISION IN MATHEMATICS EDUCATION. THE CONFERENCE WAS CONDUCTED TO ASSESS TELEVISION MATERIALS NOW BEING OFFERED IN MATHEMATICS IN ORDER TO STIMULATE THE DEVELOPMENT OF INCREASINGLY EFFECTIVE TELEVISION MATERIALS FOR THE NATION'S SCHOOLS. THERE ARE 3 SECTIONS, (1) A STATUS REPORT OF MATHEMATICS TELECOURSES BEING OFFFERED IN THE U.S. DURING 1966-67, (2) A SUMMARY OF THE DISCUSSION AMONG THE 11 MATHEMATICS AND TELEVISION AUTHORITIES PARTICIPATING IN THE CONFERENCE, AND (3) A TABULAR BREAKDOWN OF THE INFORMATION GATHERED FOR THE CONFERENCE. (MS)

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This report concerns the National Center for School and College Television's conference on television in mathematics education. The conference was conducted to assess television materials now being offered in mathematics in an effort to stimulate the development of increasingly effective television materials for the nation's schools. The report is divided into three sections:

- *Part I is a status report of mathematics telecourses being offered in the United States during the 1966-67 school year.*

- *Part II is an overview of the discussion among the eleven mathematics and television authorities who participated in the entire conference.*

- *Part III is a tabular breakdown of the information gathered for the conference. At the conference, lessons from most of the telecourses listed here were viewed.*

The eleven conferees viewed sample lessons from telecourses, reviewed print materials (teacher's manuals and student work materials), and, during the final session, considered the state of television in mathematics education.

Those who joined NCSCT staff members at the conference are Robert B. Kane of Purdue University, Don R. Lichtenberg of the University of South Florida, Lola June May of the Winnetka Public Schools in Illinois, Robert E. Morrill of the Bay Region Instructional Television for Education in California, Philip Peak of Indiana University, Billy E. Rhoades of Indiana University, Myron F. Rosskopf of Columbia University's Teachers College, Isabelle P. Rucker of the Virginia State Department of Education, Raymond L. Smith of educational television station KQED, David W. Wells of the Oakland County Schools in Michigan, and mathematics consultant Robert W. Wirtz.

Part I—THE STATUS OF TV IN MATHEMATICS EDUCATION

For its conference, NCSCT sent questionnaires to 115 ETV stations and three closed-circuit facilities. This report does not consider materials developed or offered by commercial television stations.

Fifty-seven television courses were identified in the elementary, secondary, and in-service areas.

ELEMENTARY GRADE LEVEL

GRADE EMPHASIS Of the 57 telecourses, 59 percent (34 courses) was designed for the elementary grade level: 12 for primary grades (K-3) and 22 for intermediate grades (4-6).

FREQUENCY OF TRANSMISSION Of the 34 telecourses for the elementary grades, only 15 percent was intended for use during one semester. Eighty-five percent of the telecourses was designed for use during a full academic year. Twenty-six of the 34 telecourses were designed to be transmitted at a rate of one lesson each week. Four telecourses were offered on a twice each week basis, two telecourses on a three lesson each week basis, one telecourse on a four lessons each week basis, and another on a two lessons each month basis.

RECORDED OR UNRECORDED Only one of the 34 courses was not recorded and available for reuse; even that telecourse was recorded in part.

USED BY OTHERS The majority (21 of 34) of the telecourses was used by stations other than the producing station.

SECONDARY GRADE LEVEL

GRADE EMPHASIS Of the 57 telecourses reported, 19 percent (11 courses) was designed for the secondary grade level.

FREQUENCY OF TRANSMISSION At the secondary level, less than ten percent of the telecourses was intended for use for only one semester. The remaining 91 percent of the telecourses was designed for use through a full academic year. The frequency of lesson transmissions was greater at the secondary level than at the elementary level—77 percent of the elementary level telecourses was transmitted at the one lesson each week rate while only nine percent of the secondary materials was so designed.

One secondary course was designed for a transmission rate of one lesson each week, four telecourses were designed on the basis of two lessons each week and four lessons each week, and two telecourses were intended to be used at the rate of five lessons each week.

RECORDED OR UNRECORDED Just over half (six of 11) of the telecourses were recorded and available for reuse.

USED BY OTHERS Just under half (five of 11) of the telecourses were used by stations other than the producing station.

IN-SERVICE TEACHER EDUCATION

Twenty-one percent (12 series) was designed for teacher in-service education.

FREQUENCY OF TRANSMISSION Only eight percent of the in-service teacher education series was designed for use throughout a complete academic year. Ninety-two percent of the series was intended to be used during one semester.

Eight of the series were to be transmitted at a rate of one lesson each week, three of the series were to be shown at the rate of two lessons each week, and one series was to be shown at a rate of three lessons each week.

RECORDED OR UNRECORDED All of the in-service teacher education series were recorded and available for reuse.

USED BY OTHERS Only three of the 12 series were used by stations other than the producing station.

Part II—AN OVERVIEW

During the last two days of February this year (1967), 11 men and women with wide and varied experience in mathematical education met at the National Center for School and College Television in Bloomington, Indiana, to study video tapes and kinescopes that had been gathered from all parts of the country. The purposes of the conference were (a) to view lessons from a large number of telecourses dealing with different phases of mathematical education; (b) to assess the adequacy of existing television materials for school or teacher instruction; and (c) to make suggestions for the development of more effective materials. Some of the 11 conferees had been, or were, mathematics television teachers. Others were noted for their development of materials for elementary and secondary school programs. A few were primarily interested in production of television materials for educational purposes. To use language that was common to all of the video tapes viewed: The intersection of these subsets was not empty.

With a quarter-inch thick stack of rating sheets before them, the panel settled down to watch the replays of sample lessons from 57 telecourses in mathematics. These had been gathered from every part of the country—north, south, east, and west. Most of the lessons were at the elementary school level, but some were intended for secondary school consumption—at both the junior and senior high school levels. Each tape, or film, was viewed long enough to serve as the basis for valid judgment.

Occasionally, the screening members asked that a tape be cut off at the end of a few minutes, for the familiarity of the material and the methodology shown gave an adequate indication of the whole program. At other times, one or more members insisted that a tape be run for its whole length, for they desired to see how the television teacher worked out the lesson.

A retrospective look at the television teachers seen leads to some interesting observations. There seemed to be a design to the choice made. The television teacher looked, spoke, and acted (taught) as the intended audience had become used to in ordinary classrom situations. If the audience was elementary school teachers, then the television teacher looked and spoke like any in-service teacher would have for the particular viewing public. On the other hand, for elementary school children there was a teacher who was personable, but not glamorous; who spoke as an elementary school teacher does; and who was able to generate great enthusiasm for child-like activities. In short, the classroom was transferred to videotape without the stimulating presence of pupils or students or other teachers. Consciously or unconsciously the television teachers appeared the very image of a classroom teacher. In just one case did it seem that efforts had been made to secure a dynamic personality as teacher, one who could almost qualify as a professional performer.

Mathematics Telecourses Today

Current use. Judging on the basis of the panel's viewing, there are four principal uses of television as an instructional medium: (a) in-service teacher training, (b) classroom instruction, (c) enrichment, and (d) provision of a course in mathematics that would not be available otherwise.

The in-service teacher training telecourses are directed at elementary school teachers. Quite clearly, such a course originated in a state or a school system large enough to have access to educational television facilities. Everyone of the tapes used a straight lecture method of instruction. Sometimes a few physical objects were used to illustrate a concept, but usually a small board served for this purpose. The reaction of the panel was that mass exposure to some of the ideas of a new mathematics program had been attained at a sacrifice. Such tapes never involved anyone but the television teacher.

Classroom instruction via television is going on at both the elementary and the secondary school levels. With only a few exceptions, no audience of any sort is present. These telecourses have materials related to each broadcast lesson for both the classroom teacher and students. Sometimes such a telecourse has dual purposes of pupil instruction and teacher training.

It was not clear to the panel how a school uses the enrichment television programs. Usually these are broadcast once each week. Does a whole class participate, or just a part of the class?

Perhaps the most well-known example of mathematics material not otherwise available are the NBC-"Continental Classroom" courses, "Modern Algebra and the Teaching of Modern Algebra" and "Probability and Statistics and the Teaching of Probability and Statistics." These courses included material for senior high school teachers, as well as providing a complete course in modern algebra and probability and statistics. At the conference, there was one instance of such material for the elementary grades. The others were intended for high school students. Such courses serve a need that exists, for many schools have too few students interested in advanced mathematics to justify scheduling a class. Via television, and the elaborate print materials involved, such students can obtain the instruction they desire. Calculus, for example, might be such a completely taped course.

Quality and adequacy. Television teaching in mathematics is quite ordinary. The panel did not see any television teacher that it was willing to classify as a master teacher. It is faint praise indeed to call the content of the programs 'adequate.' The content ought to be more than adequate. There were mistakes in mathematics; the use of television as a medium was pitiful; the involvement of an audience was missing. Really, the panel was of the opinion that classroom instruction patterns had been transferred, like a decal, to television instruction. The limitations of classroom instruction became even more limiting when the narrow range of a camera and the 25-inch screen of a receiver had to be taken into account.

Television as a basic and supplementary source. The majority of the panel's members were not willing to admit that mathematics telecourses served as a basic resource for instruction today. They were skeptical of the effectiveness of a program with the double purpose of pupil and teacher instruction. However, a minority clung to the point of view that a metropolitan school system with its hundreds of new elementary school teachers each year needed some sort of mass in-service training.

A telecourse, ostensibly for pupils, that had elaborate print materials for both teachers and pupils served a need that no other means of instruction could. Such a course illustrated for teachers the "what" and "how" of the mathematical concepts presented and carried these aspects of the course further with the print materials. It seemed to this minority that such a telecourse left a great deal for the teacher to do, actively involving her and the pupils.

(Continued on page 10)

Part III-TV IN

TITLE OF TELECOURSE	PRODUCER	PRODUCTION LOCATION	GRADE LEVEL	NO. OF LESSONS	LESSON LENGTH	FREQ. OF BRDCST.
		ELEMENTARY COURSES				
Arithmetic–3	KUON	Lincoln, Nebraska	3	30	15′	1/wk
Arithmetic–1	WHA	Madison, Wisconsin	1	32	15′	1/wk
Arithmetic–2	WHA	Madison, Wisconsin	2	48	15′	1/wk
Arithmetic–3	WHA	Madison, Wisconsin	3	64	15′	2/wk
Math-A-Magic	WUFT	Gainesville, Florida	3	27	20′	2/mo
Mathematics–1	KRMA	Denver, Colorado	1	35	20′	1/wk
Mathematics–2	KRMA	Denver, Colorado	2	35	20′	1/wk
Mathematics–3	KRMA	Denver, Colorado	3	34	20′	1/wk
Shapes In Space	WETA	Washington, D. C.	2–3	8	15′	1/wk
Sets and Symbols	WTVS	Detroit, Michigan	2	37	15′	2/wk
Today's Math–2	WCVE	Richmond, Virginia	2	31	15′	1/wk
Today's Math–3	WCVE	Richmond, Virginia	3	30	20′	1/wk
		INTERMEDIATE COURSES				
Arithmetic–4	WHA	Madison, Wisconsin	4	68	15′	2/wk
Patterns in Arithmetic–5	WHA	Madison, Wisconsin	5	68	15′	3/wk
Patterns in Arithmetic–6	WHA	Madison, Wisconsin	6	68	15′	3/wk
Arithmetic–4	KUON	Lincoln, Nebraska	4	30	15′	1/wk
Arithmetic–5	KUON	Lincoln, Nebraska	5	30	15′	1/wk
Arithmetic–6	KUON	Lincoln, Nebraska	6	30	15′	1/wk
Exploring Mathematics	Co. P. S.*	Los Angeles, Calif.	6	27	20′	1/wk
Exploring Mathematics	WNDT	New York, N. Y.	5–6	64	20′	2/wk
Let's Figure–4	KQED	San Francisco, Calif.	4	27	20′	1/wk
Let's Solve It–5	KQED	San Francisco, Calif.	5	27	20′	1/wk
Mathematics	WILL	Carbondale, Illinois	5–6	12	30′	1/wk
Mathematics–4	KRMA	Denver, Colorado	4	31	20′	1/wk
Mathematics–5	KRMA	Denver, Colorado	5	31	20′	1/wk
Mathematics–6	KRMA	Denver, Colorado	6	35	20′	1/wk
Mathematics–6	WNYE	Brooklyn, N. Y.	6	15	20′	1/wk
Primary Concepts of Math	D. P. I.†	State of Pennsylvania	3–4	15	15′	1/wk
Speaking of Numbers	WMHT	Schenectady, N. Y.	5–6	28	30′	1/wk
Take a Number	KQED	San Francisco, Calif.	6	27	20′	1/wk

MATHEMATICS EDUCATION

TITLE OF TELECOURSE	PRODUCER	PRODUCTION LOCATION	GRADE LEVEL	NO. OF LESSONS	LESSON LENGTH	FREQ. OF BRDCST.
Today's Math–4	WCVE	Richmond, Virginia	4	30	20′	1/wk
Today's Math–5	WCVE	Richmond, Virginia	5	30	20′	1/wk
Today's Math–6	WCVE	Richmond, Virginia	6	30	25′	1/wk
Wonderful World of Numbers	MPATI	Lafayette, Indiana	6	128	20′	4/wk
SECONDARY COURSES						
Algebra I		South Carolina ETV	8–9	160	30′	5/wk
Algebra II		South Carolina ETV	9–10	160	30′	5/wk
Calculus	WHRO	Norfolk, Virginia	10–12	125	30′	4/wk
Calculus	WENH	Durham, New Hampshire	10–12	120	30′	4/wk
Greater Cleveland Math	WVIZ	Cleveland, Ohio	6–9	15	30′	1/wk
Mathematics–7	WFPK	Louisville, Ky.	7	144	20′	4/wk
Mathematics–8	WFPK	Louisville, Ky.	8	144	20′	4/wk
Modern Mathematics–7	KTCA	Minneapolis, Minn.	7	62	30′	2/wk
Patterns in Mathematics	WHA	Madison, Wisconsin	8–9	76	25′	2/wk
Seeing Through Mathematics–1		Arlington Hts., Ill.	7	38	20′	2/wk
The Third R		Alabama ETV	11–12	76	25′	2/wk
IN-SERVICE TEACHER COURSES						
Computational Skills	City P. S.*	Los Angeles, Calif.	In-s	4	30′	1/wk
Math Education	WFSU	Tallahassee, Florida	In-s	28	25′	1/wk
Math In-service	KTCA	Minneapolis, Minn.	In-s	12	30′	1/wk
Mathematics	KFME	Fargo, N. D.	In-s	10	30′	1/wk
Mathematics	KFME	Fargo, N. D.	In-s	24	50′	2/wk
Modern Mathematics	WNED	Buffalo, N. Y.	In-s	30	30′	2/wk
Sets and Systems	WETA	Washington, D. C.	In-s	15	30′	1/wk
SMSG Math	WPSX	Univ. Park, Penn.	In-s	30	30′	1/wk
Structure of Arithmetic & Algebra	KDPS	Des Moines, Iowa	In-s	15	30′	1/wk
Teaching Mathematics	KTCA	Minneapolis, Minn.	In-s	15	30′	1/wk
Teaching Modern Math	WPSX	University Park, Penn.	In-s	38	30′	3/wk
The Third R		Mohawk-Hudson ETV, N. Y.	In-s	35	30′	2/wk

*Public Schools
†Department of Public Instruction

The panel grudgingly admitted that a television course was a resource for students in isolated sections of the country. Some schools are so small that many capable students cannot get the courses they desire and need for effectively going further in their education. The panel affirmed wholeheartedly that these students deserved better instruction than illustrated by the lessons it viewed.

As a resource for supplementary instruction in mathematics, television has an important role to play. Perhaps because it is such a troublesome problem for mathematics teachers, the panel emphasized the necessity for programs that would serve as motivation for topics in mathematics. Another supplementary resource mentioned by several members of the panel was illustration of ways to teach troublesome units. The division algorithm and introduction of negative members were cited as examples. A third use of television that the panel envisioned was for enrichment. By this the panel meant exploring a topic more deeply than a classroom teacher was able to do. Such a unit would use all of the visual techniques available to a studio but not to the classroom teacher. Also, by enrichment the panel meant development of supplementary topics for different levels of student capabilities. There was a firm belief expressed that low achievers needed such material, especially prepared for them, just as much as honors students needed to go beyond a standard syllabus.

Mathematics Television Tomorrow

The television teacher. The panel became convinced as lesson followed lesson that something must be done to make a television teacher more effective. As mentioned earlier, the prototype for choice of a teacher seemed to be a rather ordinary classroom teacher. Some quite obviously had had little instruction in what to do when working in this new medium. Direction was not apparent at all. Camera work was mediocre. The present fad for camera close-ups has no place in school television. It isn't the teacher that the camera needs to watch but the mathematics being taught or the visual being used.

The panel at one point erupted into a period of lamenting that it seemed as if nothing had been learned from ETV's experience. Most tapes showed no evidence of knowledge of what had been learned in school television during the past decade. Something must be done for the television teacher.

One suggestion made by the panel was that the National Center for School and College Television establish workshops for those persons who are going to be television teachers. Such workshops, or institutes, would serve to inform participants of the information gleaned from evaluation of ETV and expose them to a variety of points of view as expressed by experts in the field. There might be illustration also of effective ways for a television teacher to function when on camera. Dress, voice, gestures, and cooperation with camera crews and directors—all could form part of the instruction. Such workshops would not need to have participants from the same subject, for the emphasis would be on techniques that transcend subject matter.

An unusual suggestion that came from the panel was that the classroom teacher who views the television program needs instruction. In fact, the panel went on to suggest that television itself might be used to train a teacher. It is not clear whose responsibility such training becomes. Is it that of an individual teacher education program? Or does it, perhaps, belong to the school supervisory program? In the latter case, it would be on-the-job training, a place where the instruction often proves to be most effective.

The characteristics of an effective television teacher, other than knowledge of the medium's techniques, are the same as those of a master classroom teacher. Two are worthy of mention. He must be dynamic; there must be apparent on the screen movement, action, and involvement of the audience. Secondly, he must be willing to subject himself to severe self-criticism. By examining his own actions, perhaps watching a rehearsal tape, he can and should improve.

An effective television lesson. There was some discussion of the requirements of different sections of the country. Perhaps some regions needed a different sort of program than another. This idea received little favorable comment, for the majority of the panel members felt that the responsibility of the National Center was country wide.

Rather, the panel asserted, there was need for a variety of materials, well focused, and with a carefully described and circumscribed audience. The panel believed that distribution of programs should be selective. A corollary is that a user should be discouraged from using a program for an audience that did not fit the one described in the program. In the opinion of the panel, too many of the lessons tried to be all things to all people. That is, too many mathematical ideas were touched upon. Too many audiences were contemplated. The better lessons treated one mathematical concept in some depth, contained good methodology, and focussed, for example, on a particular elementary school grade.

Somehow, the viewing group felt much more involved in a lesson if there were students present, not primed with answers but actively trying to understand and to master the concept being presented by the television teacher. In view of the recommendation of the preceding paragraph, it seems that some children will be necessary participants in future mathematics television. With them present, a television teacher can demonstrate the sort of classroom procedures that are preferred today. The panel asserted that one important function of ETV might be to present new and better ways to involve children, elementary and secondary, in the learning of mathematics.

A problem that the panel spent some time discussing should be mentioned. This is the potential danger of a telecourse alienating teachers. The members felt that danger existed if the points of view presented via television differed in too many respects from those of the on-ground teachers. An implication seems to be that a mathematics telecourse cannot be revolutionary in character but must be evolutionary. The differences between the viewing teachers and the television teacher might occur with respect to methods or content or, particularly at the elementary school level, approaches to the standard algorithms. These days there are strong opinions about the language, the words used in mathematics programs. If the television teacher's use of language does not meet the standards of the viewing teachers, there is likely to be a complete rejection of the program.

What might be done? Teachers are aware of the need to improve the teaching of mathematics, and they also know that there are ways to learn more about mathematics. But the panel insisted the time is rapidly passing in many sections of the country for in-service mathematics courses for teachers. Success

for future telecourses will depend upon new approaches to teacher education. A possibility for such a new approach, suggested by a member, is to design a telecourse that presents good mathematics in the way in which viewers might teach the mathematics. That is, turn to methodology. Epigrammatically, one might say that teachers know the mathematics and now they want to know what to do with it.

At the end of the two days of looking at what exists now in mathematics telecourses, the panel's conclusion was that the medium of television had not yet been used to advantage. There are too many shoestring operations. Someone with an idea writes a proposal, secures a grant, and goes into production. This is not the way to produce quality school television programs, in mathematics or in any other field. The time has come for more professional—and more costly, perhaps—work on television programs. The panel felt there ought to be more informal evaluation of programs. For example, a prototype tape could be made, tried out in a few places to secure criticism. Only then should the full program be developed.

Besides programs devoted to troublesome units of work and motivation mentioned earlier, the panel believed there should be some programs that made clear the relationship of mathematics to other parts of the curriculum. Perhaps such programs can be classified as motivational, but that was not really the tenor of the panel discussion. Rather the panel felt there exists a responsibility to make as clear as possible the inter-relations of mathematics and our increasingly technically oriented culture. Also found missing by the panel were programs that made clear the structure of mathematics. What is desired is not just a list of axioms and a formal presentation of their use in mathematical proof but a development, through presentation of many examples, of how the same set of statements characterize all of those examples.

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THE NATIONAL CENTER FOR SCHOOL AND COLLEGE TELEVISION serves all institutions concerned with the use of television in education. NCSCT makes available recorded lessons of the highest quality for preschool, elementary, secondary, college, extension, industrial, and continuing professional education.

To relate its activities to the major needs of institutions throughout the United States, NCSCT works closely with content specialists, administrators, professional groups, and regional television organizations.